

CLAIMS

What is claimed is:

1. A method of storing and ordering image data in a database comprising:
gathering a plurality of images for inclusion in the database;
5 computing a match descriptor indicative of each of the plurality of
images, each of the match descriptors corresponding to a multidimensional
space; and
organizing the match descriptors in the database, the organizing being
performed according to a predetermined metric indicative of a correspondence
10 between a given match descriptor and the other match descriptors in the
database.
2. The method of claim 1 wherein a match descriptor is a vector quantity.
3. The method of claim 2 wherein the correspondence is a similarity of the match
descriptors.
- 15 4. The method of claim 1 wherein the predetermined metric is a distance metric.
5. The method of claim 4 wherein the distance metric is derived from a similarity
metric, the similarity metric operable to determine match descriptors near to
other match descriptors based on a distance in the multidimensional space.
6. The method of claim 1 wherein computing the match descriptor includes
20 computing a Fourier-Mellin Transform (FMT).
7. The method of claim 6 further comprising vector quantization of the FMT.

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8. The method of claim 1 wherein the match descriptors are invariant descriptors.
9. The method of claim 8 wherein the invariant descriptors are insensitive to geometric translations.
10. The method of claim 1 wherein the organizing according to a predetermined metric further comprises Locality-Sensitive Hashing (LSH).
11. A method for finding images in a database comprising:
 - providing a database of stored images, each of the stored images represented by a match descriptor, the match descriptors corresponding to a multidimensional space and organized according to a similarity metric in the multidimensional space;
 - providing a target image for which a match is sought in the database;
 - computing a target descriptor corresponding to the target image;
 - selecting a candidate match descriptor from the organized match descriptors in the database;
 - computing, according to the similarity metric, a distance between the candidate match descriptor and the target descriptor; and
 - returning, as the matching image, the candidate match descriptor if the computed distance from the candidate match descriptor to the target descriptor is within a predetermined distance threshold.
12. The method of claim 11 further comprising returning if a null search criteria is satisfied.
13. The method of claim 11 further comprising selecting a successive candidate match descriptor, each of the successive candidate match descriptors computed from match descriptors near the former candidate match descriptors.

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14. The method of claim 11 wherein the selecting of the database is a nearest-neighbor mapping.
15. The method of claim 11 wherein the predetermined distance threshold is satisfied if the similarity metric indicates that the candidate match descriptor is sufficiently near the target descriptor in the multidimensional space.
16. The method of claim 12 wherein the null search criteria further comprises a predetermined maximum distance.
17. The method of claim 11 wherein the stored images further comprise visual image data.
18. A method for storing and retrieving image data comprising:
- providing a plurality of match images;
 - computing a match descriptor corresponding to a multidimensional space indicative of each of the match images;
 - organizing each of the match descriptors in a database according to a predetermined similarity metric, the similarity metric operable to indicate match descriptors that are near to other match descriptors in the multidimensional space;
 - receiving a target image for which a match is sought;
 - computing a target descriptor indicative of the target image;
 - mapping into the database to determine a close match of the target descriptor among the organized match descriptors, a close match determined by a distance to a near match descriptor within a predetermined threshold, the mapping further comprising:
 - selecting a candidate match descriptor from among the organized match descriptors; and

returning the candidate match descriptor if the candidate match descriptor is a match to the target descriptor, the match being determined by a similarity metric.

19. The method of claim 18 further comprising selecting another candidate match
5 descriptor if the candidate match descriptor is not a match to the target descriptor, the selecting occurring from among match descriptors organized near the candidate match descriptors.
20. The method of claim 18 wherein near match descriptors are similar vectors in the multidimensional space.
- 10 21. The method of claim 18 wherein the similarity metric is a set similarity metric.
22. A system for finding stored images comprising:
a database of stored images, each of the stored images represented by a
match descriptor, the match descriptors corresponding to a multidimensional
space and organized according to a similarity metric in the multidimensional
15 space;
a descriptor constructor operable to compute a target descriptor
corresponding to a target image for which a match is sought in the database;
a database mapper operable to select a candidate match descriptor from
mapping near match descriptors in the database; and
20 a similarity processor operable to compute, according to the similarity metric, a distance between the candidate match descriptor and the target descriptor, and further operable to return, as a matching descriptor, the candidate match descriptor if the computed distance to the target descriptor is within a predetermined distance threshold.

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23. The method of claim 22 wherein the similarity processor is further operable to terminate the search if a null search criteria is satisfied.
24. The system of claim 22 wherein the match descriptors and the target descriptor are vector quantities.
- 5 25. The system of claim 22 wherein the similarity processor is further operable to compute the distance based on the similarity in the magnitude of the match descriptors and the target descriptor.
26. The system of claim 22 wherein the descriptor constructor computes the target descriptors by computing a Fourier-Mellin Transform (FMT).
- 10 27. The method of claim 26 wherein the descriptor constructor is further operable to determine vector quantization of the FMT.
28. The system of claim 22 wherein the similarity metric further comprises Locality-Sensitive Hashing (LSH).
29. The system of claim 22 wherein the match descriptors are invariant descriptors.
- 15 30. The system of claim 29 wherein the invariant descriptors are insensitive to geometric translations.
31. The system of claim 22 wherein the predetermined distance threshold is satisfied if the similarity metric indicates that the candidate match descriptor is sufficiently near the target descriptor in the multidimensional space.

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32. The system of claim 23 wherein the null search criteria further comprises a predetermined maximum distance.

33. A computer program product having computer program code for finding images in a database comprising:

- 5 computer program code for accessing a database of stored images, each of the stored images represented by a match descriptor, the match descriptors corresponding to a multidimensional space and organized according to a similarity metric in the multidimensional space;
- 10 computer program code for providing a target image for which a match is sought in the database;
- computer program code for computing a target descriptor corresponding to the target image;
- computer program code for selecting a candidate match descriptor from the match descriptors in the database;
- 15 computer program code for computing, according to the similarity metric, a distance between the candidate match descriptor and the target descriptor; and
- 20 computer program code for returning, as the matching image, the candidate match descriptor if the distance from the candidate match descriptor to the target descriptor is within a predetermined distance threshold.

34. A computer data signal for finding images in a database comprising:

25 program code for accessing a database of stored images, each of the stored images represented by a match descriptor, the match descriptors corresponding to a multidimensional space and organized according to a similarity metric in the multidimensional space;

program code for providing a target image for which a match is sought in the database;

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program code for computing a target descriptor corresponding to the target image;

program code for selecting a candidate match descriptor from the match descriptors in the database;

5 program code for computing, according to the similarity metric, a distance between the candidate match descriptor and the target descriptor; and

 program code for returning, as the matching image, the candidate match descriptor if the distance from the candidate match descriptor to the target descriptor is within a predetermined distance threshold.

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35. A system for finding stored images comprising:

 means for accessing a database of stored images, each of the stored images represented by a match descriptor, the match descriptors corresponding to a multidimensional space and organized according to a similarity metric in the multidimensional space;

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 means for providing a target image for which a match is sought in the database;

 means for computing a target descriptor corresponding to the target image;

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 means for selecting a candidate match descriptor from the match descriptors in the database;

 means for computing, according to the similarity metric, a distance between the candidate match descriptor and the target descriptor; and

 means for returning, as the matching image, the candidate match descriptor if the distance from the candidate match descriptor to the target descriptor is within a predetermined distance threshold.

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